Third United Nations International Conference on the Peaceful Uses of Atomic Energy

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Abstract

CHEMICAL TREATMENT OF URANIUM ORES AT THE MINES, IN A SEMI-MOBILE PLANT

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In the uraniferous area situated in the north-east of Portugal far away from the only industrial uranium chemical treatment plant existing in the country, a few small dispersed deposits are found, each containing about 10 to 50 t of uranium. The relatively small reserves and the dispersion of the deposits would not justify the building of a conventional plant in that area. For this reason studies were directed to develop an economical process of uranium concentration, involving equipment that might be easily moved from mine to mine.

Studies were carried out with a view to reducing or eliminating bulky operations, such as grinding and liquid-solids separation. The treatment of the ores after a coarse crushing was tried. Bench scale studies were carried out, the two following processes having been tried:

a) The ore was imbibed with a sulphuric acid solution, and after different periods of time was watered to remove soluble uranium.

b) The ore was sprinkled with a sulphuric acid solution, and later was watered to remove soluble uranium.

These two processes were applied with encouraging results to several kinds of ores, with the exception of the alkaline and impermeable ores.

In particular, the treatment of Forte Velho ore, which essentially consists of a weathered granitic rock with torbenite mineralization, was studied in great detail. In the laboratory experiments, from an ore containing 0.2% U_3O_8, ground to minus 1/2", placed in small columns, a recovery of 80% of the uranium was obtained, with an acid consumption lower than 25 kg per ton of ore. The results also suggested the advantages of recirculating the richer acid leach liquors through fresh ores, and of using higher columns in order to increase the contact time between the ore and the acid solution.

Based on these experiments, a 35 t./day pilot plant was designed. The plant comprises essentially:

a) Equipment for crushing the ore to minus 1/2".

b) A set of cells where the ore is stocked, sprinkled and watered.

c) A set of tanks to collect leach liquors and to adjust the pH.

d) Ion exchange columns.

e) Equipment for precipitation and filtration of the concentrate.

This plant has been running since May 1962. The uranium recovery has been about 75% in spite of frequent variations of characteristics and grade of the uranium ores being treated. The uranium concentrate contains about 75% U_3O_8.

Details about the equipment and on operating costs are mentioned. Reference is also made to some problems concerned with the plant operation such as:

a) Behaviour of the ion exchange resins.

b) Attempts to eliminate phosphate interferences in the elution.

c) Treatment of the ores by immersion in a sulphuric acid solution.

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Abstract

PORTUGUESE REQUIREMENTS AND SUPPLY CAPABILITIES REGARDING NUCLEAR FUELS

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In presenting the basic data for their paper, the authors refer to the existence of considerable uranium reserves and of a uranium mining industry in Portugal, also to the predicted growth of electric power consumption through the year 2000 and to the possible share of nuclear energy in meeting the increased power requirements.

An examination of fuel consumption both in qualitative and in quantitative terms according to various types of reactors, leads to the determination of uranium requirements for each one of such reactor types and for each one of some nuclear power programmes postulated by the authors.

The size of the uranium mining industry and some of the factors on which it depends, are then studied in confrontation with uranium reserves and with uranium requirements as determined above. The interest in and the possibilities of installing fuel element fabricating facilities, as well as related questions of general policy are also discussed.

An analysis is finally made of the various possibilities of developping the utilization of uranium resources, and of the respective implications in the field of international cooperation.

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Abstract

PORTUGUESE RESEARCH REACTOR

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A detailed analysis is made of the existing programmes for the utilization of the 1 MW swimming pool type Portuguese Research Reactor and of the means presently available or required to implement those programmes.

The advantages of promoting cooperation with universities and national or foreign research centers are discussed.

Incidentally, the most relevant features of the reactor, which is similar to other well known reactors of the same type, are described briefly. A short summary analysis of the facility is made having in mind the experimental work which is in progress or planned. A summary of the results obtained during the calibration of the reactor is also presented.

The contribution of the reactor to the development of the "Laboratório de Física e Engenharia Nucleares" (Portuguese Nuclear Research Center) and to scientific development in Portugal is referred to. On the other hand difficulties prevailing in this field and calling for a determined effort in promoting scientific and technological research are examined. The need for systematic training of personnel for the future nuclear activities and the utilization of this research reactor by other institutions are also considered.

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Abstract

URANIUM ALLOYS

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In connection with a study of uranium alloys, two mechanisms for improving the behaviour of metallic uranium under irradiation were examined.

The mechanism of grain refinement was investigated by studying the β/α transformation in dilute uranium alloys, and the γ phase stabilisation in high concentration alloys was studied by following the mechanism of $\gamma \rightarrow \alpha + \gamma'$ decomposition.

As regards the β/α transformation, both the rate of growth, G, and the rate of nucleation, N, were measured in several alloys [1], the former from the change in length of isothermally formed columnar grains.

It was found that the results could be expressed in terms of the Volmer-Turnbull theories of nucleation and growth. The interfacial energies $\sigma_{\alpha\beta}$ of the various alloys were calculated on this basis, both from nucleation and from growth, and were found to be of the same order of magnitude.

Assuming that linear extrapolation of the $\sigma_{\alpha\beta}$ values found for the various alloys to zero chromium is permissible, the value of the interfacial energy for pure uranium from both nucleation and growth measurements is 6 ergs/cm^2.

The appearance of columnar grains permitted the measurement of dihedral angles, whence could be calculated values of the ratio $\sigma_{\alpha\beta}/\sigma_{\alpha\alpha}$ where $\sigma_{\alpha\alpha}$ is the

interfacial α,α grain boundary energy.

The internal structure of these alloys was also examined, using super pure uranium for alloying. Clear pearlite structure was revealed, with characteristic "Hebrew Script" sub-lamellae.

An attempt was also made, taking the values of G and N, to calculate the overall transformation on the basis of the Johnson and Mehl theory.

The study of the $\gamma \rightarrow \alpha + \gamma'$ transformation was carried out on uranium high-molybdenum alloys using crystallographic techniques for determining the two TTT curves for the $\gamma \rightarrow \alpha$; $\gamma \rightarrow \gamma'$ transformation. It was found that both curves are strongly affected by small impurities, which may explain discrepancies in previous work.

REFERENCE

[1] BAR-OR, A., WYNBLATT, P., and HIRSCH, G., Nature 199 (1963) 585/586.